Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (previously presented) A method for providing an early warning of thermal decay, comprising:

writing a test pattern to a track of a magnetic disk, wherein said test pattern has a higher data density than a data density of user data in said track;

measuring an amplitude of a signal produced by reading said test pattern;

storing said measured amplitude;

reading said test pattern from said track to obtain an observed amplitude of a signal produced by said test pattern;

comparing said measured amplitude to said observed amplitude; and

producing a thermal decay warning signal if said comparison is unfavorable.

2. (previously presented) The method of Claim 1, wherein said test pattern has a test frequency in said track that is higher than a nominal data frequency for user data in said track.

3. (previously presented) The method of Claim 2, wherein said track is located within a first zone of said magnetic disk, said test frequency is a nominal data frequency for user data in a second zone of said magnetic disk, and said first zone is located towards an inside diameter of said magnetic disk relative to said second zone.

4. (previously presented) The method of Claim 1, further comprising identifying a sector of said magnetic disk at which a magnetic medium of said magnetic disk is thinner than an average thickness of said magnetic medium, and then writing said test pattern to said sector in response to said identification.

5. (previously presented) The method of Claim 4, further comprising identifying said sector by measuring the amplitude of signals produced by automatic gain control fields, wherein said identified sector is associated with one of said automatic gain control fields producing an amplitude that is less than a nominal amplitude for said automatic gain control fields.

6. (previously presented) The method of Claim 1, further comprising, in response to said thermal decay warning signal, refreshing data stored on said magnetic disk.

7. (previously presented) The method of Claim 1, wherein said test pattern is written to each data storage surface of each magnetic disk included in a hard disk drive.

8. (previously presented) The method of Claim 1, wherein said steps of reading said test pattern, comparing said measured amplitude, and producing said thermal decay warning signal are performed periodically.

9. (previously presented) The method of Claim 1, further comprising creating a predetermined portion of said magnetic disk having a greater than average susceptibility

to thermal decay during manufacture of said magnetic disk, and then writing said test pattern to said predetermined portion of said magnetic disk in response to identifying said predetermined portion of said magnetic disk.

10. (original) The method of Claim 1, wherein said test pattern is written in accordance with a longitudinal recording scheme.

11. (previously presented) A method for providing an early warning of thermal decay, comprising:

writing a test pattern to a track of a magnetic disk, wherein said test pattern has a lower data density than a data density of user data in said track;

measuring an amplitude of a signal produced by reading said test pattern;

storing said measured amplitude;

reading said test pattern from said track to obtain an observed amplitude of a signal produced by said test pattern;

comparing said measured amplitude to said observed amplitude; and

producing a thermal decay warning signal if said comparison is unfavorable.

12. (previously presented) The method of Claim 11, wherein said test pattern has a test frequency in said track that is lower than a nominal data frequency for user data in said track.

13. (previously presented) The method of Claim 12, wherein said track is located within a first zone of said magnetic disk, said test frequency is a nominal data frequency for user data in a second zone of said magnetic disk, and said first zone is located towards an outside diameter of said magnetic disk relative to said second zone.

14. (previously presented) The method of Claim 11, further comprising identifying a sector of said magnetic disk at which a magnetic medium of said magnetic disk is thinner than an average thickness of said magnetic medium, and then writing said test pattern to said sector in response to said identification.

15. (previously presented) The method of Claim 14, further comprising identifying said sector by measuring the amplitude of signals produced by automatic gain control fields, wherein said identified sector is associated with one of said automatic gain control fields producing an amplitude that is less than a nominal amplitude of said automatic gain control fields.

16. (original) The method of Claim 11, further comprising, in response to said thermal decay warning signal, refreshing data stored on at least a portion of said magnetic disk.

17. (previously presented) The method of Claim 11, wherein said test pattern is written to each data storage surface of each magnetic disk included in a hard disk drive.

18. (previously presented) The method of Claim 11, wherein said steps of reading said test pattern, comparing said measured amplitude, and producing said thermal decay warning signal are performed periodically.

19. (previously presented) The method of Claim 11, further comprising creating a predetermined portion of said magnetic disk having a greater than average susceptibility to thermal decay during manufacture of said magnetic disk, and then writing said test pattern to said predetermined portion of said magnetic disk in response to identifying said predetermined portion of said magnetic disk.

20. (original) The method of Claim 11, wherein said test pattern is written in accordance with a perpendicular recording scheme.

21. (previously presented) A method for detecting thermal decay in a hard disk drive, comprising:

identifying a sector of a magnetic disk having a magnetization that is less than an average magnetization for said magnetic disk;

writing an early warning pattern to said sector;

reading an amplitude of said early warning pattern to obtain a reference amplitude;

storing said reference amplitude;

reading an amplitude of said early warning pattern to obtain an observed amplitude; and

producing a thermal decay warning signal if said observed amplitude is less than said reference amplitude by more than a predetermined amount.

22. (previously presented) The method of Claim 21, further comprising identifying said sector by observing an amplitude of a selected type of servo sector information written to said disk, and then writing said early warning pattern to said sector in response to said identification, wherein said sector is associated with one of said selected type of servo sector information having an amplitude that is at least about 10% less than an average amplitude of said selected type of servo sector information.

23. (previously presented) The method of Claim 22, wherein said selected type of servo sector information comprises automatic gain control information.

24. (previously presented) The method of Claim 21, further comprising identifying said sector by identifying an area of said magnetic disk having a magnetic media thickness that is less than an average thickness of said magnetic media, and then writing said early warning pattern to said sector in response to said identification, wherein said sector is located in said area of said magnetic disk.

25. (previously presented) The method of Claim 21, further comprising producing a predetermined area of said magnetic disk having a magnetic media thickness that is less than an average thickness of said magnetic media, and then writing said early warning pattern to said sector in response to identifying said predetermined area of said magnetic

disk, wherein said sector has a magnetization that is less than an average magnetization for said magnetic disk and is located within said predetermined area of said magnetic disk.

26. (previously presented) The method of Claim 25, wherein said hard disk drive stores data according to a longitudinal recording scheme, and said predetermined area of said magnetic disk is located towards an inner diameter of said magnetic disk.

27. (previously presented) The method of Claim 25, wherein said disk drive stores data according to a perpendicular recording scheme, and said predetermined area of said magnetic disk is located towards an outer diameter of said magnetic disk.

28. (previously presented) The method of Claim 21, wherein said hard disk drive stores data according to a longitudinal recording scheme, and said early warning pattern has a frequency in said sector greater than a nominal data frequency for user data stored on a track comprising said sector.

29. (previously presented) The method of Claim 21, wherein said disk drive stores data according to a perpendicular recording scheme, and said early warning pattern has a frequency in said sector less than a nominal data frequency for user data stored on a track comprising said sector.

30. (original) A method of detecting thermal decay in a magnetic storage device, comprising:

writing a test pattern having a greater susceptibility to thermal decay than a 1T pattern to a magnetic storage medium;

reading an amplitude of a signal produced by said test pattern to obtain a reference amplitude;

storing said reference amplitude;

reading an amplitude of a signal produced by said test pattern to obtain an observed amplitude;

comparing said reference amplitude to said observed amplitude; and

in response to an unfavorable comparison, producing a thermal decay warning signal.

31. (previously presented) The method of Claim 30, further comprising:

writing a first evaluation test pattern to said magnetic storage medium;

writing a second evaluation test pattern to said magnetic storage medium; and

selecting said test pattern from said first and second evaluation test patterns.

32. (previously presented) The method of Claim 30, further comprising identifying a portion of said magnetic storage medium having a susceptibility to thermal decay that is greater than an average susceptibility to thermal decay of said magnetic storage medium, and then writing said test pattern to said portion of said magnetic storage medium in response to said identification.

33. (previously presented) The method of Claim 32, wherein said portion of said magnetic storage medium has a less than average magnetic storage material thickness.

34. (original) The method of Claim 30, wherein said magnetic storage device stores data according to a longitudinal recording scheme.

35. (original) The method of Claim 30, wherein said magnetic storage device stores data according to a perpendicular recording scheme.

36. (previously presented) A hard disk drive, comprising:

a base;

a magnetic storage disk comprising a magnetic storage material and data tracks;

a transducer head for reading and writing information to and from said data tracks, wherein said information comprises a test pattern, and said transducer head is movable in a radial direction with respect to said disk to address a selected one of said data tracks;

a voice coil motor for moving said transducer head with respect to said data tracks;

a controller, interconnected to said voice coil motor, for controlling a position of said transducer head with respect to said data tracks; and

a channel, interconnected to said transducer head, wherein an amplitude of a signal derived from said test pattern in a data track of said data tracks and having a

greater susceptibility to thermal decay than user data in said data track is transmitted by said channel, and a thermal decay warning signal is generated if said amplitude of said warning signal is less than a reference amplitude.

37. (previously presented) The hard disk drive of Claim 36, wherein said test pattern is written to an area of said magnetic storage disk having a magnetic storage material thickness that is less than a prescribed amount in response to identifying said area of said magnetic storage disk.

38. (previously presented) The hard disk drive of Claim 37, wherein said prescribed amount has a thickness that is less than about 90% of an average thickness of said magnetic storage material.

39. (previously presented) The hard disk drive of Claim 37, wherein said magnetic storage disk is formed having a magnetic storage material thickness that is intentionally reduced in said area of said magnetic storage disk.

40. (previously presented) The hard disk drive of Claim 36, wherein said test pattern is written to an area of said magnetic storage disk having an increased probability that magnetic domains in said area will return to a direction occupied by said magnetic domains in response to identifying said area of said magnetic storage disk.

41. (previously presented) The hard disk drive of Claim 36, wherein said hard disk drive stores data using a longitudinal recording scheme, said data track is located in a first zone of said magnetic storage disk, said test pattern has a test frequency that corresponds to a data frequency for user data located in a second zone of said magnetic storage disk, and said second zone is located farther from an interior diameter of said magnetic storage disk than is said first zone.

42. (previously presented) The hard disk drive of Claim 36, wherein said hard disk drive stores data using a perpendicular recording scheme, said data track is located in a first zone of said magnetic storage disk, said test pattern has a test frequency that corresponds to a data frequency for user data located in a second zone of said magnetic storage disk, and said second zone is located farther from an outside diameter of said magnetic storage disk than is said first zone.

43. (previously presented) The hard disk drive of Claim 36, wherein said hard disk drive stores data using a longitudinal recording scheme, and said test pattern has a test frequency in said data track that is greater than a nominal frequency of said user data in said data track.

44. (previously presented) The hard disk drive of Claim 36, wherein said hard disk drive stores data using a perpendicular recording scheme, and said test pattern has a test frequency in said data track that is less than a nominal frequency of said user data in said data track.

45. (previously presented) The hard disk drive of Claim 36, wherein said hard disk drive stores data using a perpendicular recording scheme, and said test pattern comprises a 12T pattern or greater.

46. (previously presented) The hard disk drive of Claim 36, wherein said hard disk drive stores data using a perpendicular recording scheme, and said test pattern comprises a 24T pattern or greater.

47. (previously presented) A hard disk drive, comprising:

a base;

a magnetic storage disk comprising a magnetic storage material and data tracks, wherein a data track of said data tracks has a reduced magnetization capacity;

a transducer head for reading and writing information to and from said data tracks, wherein said information comprises a test pattern, and said transducer head is movable in a radial direction with respect to said disk to address a selected one of said data tracks;

a voice coil motor for moving said transducer head with respect to said data tracks;

a controller, interconnected to said voice coil motor, for controlling a position of said transducer head with respect to said data tracks; and

a channel, interconnected to said transducer head, wherein an amplitude of a signal derived from said test pattern in said data track and having a different data density in said data track than user data in said data track is transmitted by said channel, and a

thermal decay warning signal is generated if said amplitude of said warning signal is less than a reference amplitude.

48. (previously presented) The hard disk drive of Claim 47, wherein said reduced magnetization capacity of said data track corresponds to a reduced magnetic storage material thickness.

49. (previously presented) The hard disk drive of Claim 48, wherein an area of said magnetic storage disk comprising said data track and said reduced magnetic storage material thickness is formed at a predetermined location on said magnetic storage disk.

50. (previously presented) The hard disk drive of Claim 49, wherein said hard disk drive stores data according to a longitudinal recording scheme, and said predetermined location is towards an inside diameter of said magnetic storage disk.

51. (previously presented) The hard disk drive of Claim 49, wherein said hard disk drive stores data according to a perpendicular recording scheme, and said predetermined location is towards an outside diameter of said magnetic storage disk.

52. (previously presented) The hard disk drive of Claim 47, wherein said hard disk drive stores data according to a longitudinal recording scheme, and said test pattern has a higher frequency in said data track than a user data frequency in said data track.

53. (previously presented) The hard disk drive of Claim 47, wherein said hard disk drive stores data according to a perpendicular recording scheme, and said test pattern comprises a 12T or greater pattern.

54. (previously presented) The hard disk drive of Claim 47, wherein said hard disk drive stores data according to a perpendicular recording scheme, and said test pattern comprises a 24T or greater pattern.

55. (previously presented) The hard disk drive of Claim 47, wherein said hard disk drive stores data according to a perpendicular recording scheme, and said test pattern comprises a 12T pattern and a 24T pattern.

56. (previously presented) A hard disk drive, comprising:

a base;

a magnetic storage disk comprising a magnetic storage material and data tracks, wherein a data track of said data tracks has a reduced magnetization capacity;

a transducer head for reading and writing information to and from said data tracks, wherein said information comprises an early warning pattern, and said transducer head is movable in a radial direction with respect to said disk to address a selected one of said data tracks;

a voice coil motor for moving said transducer head with respect to said data tracks;

a controller, interconnected to said voice coil motor, for controlling a position of said transducer head with respect to said data tracks; and

a channel, interconnected to said transducer head, wherein an amplitude of a signal derived from said early warning pattern in said data track and having a greater susceptibility to thermal decay than a 1T pattern in said data track is transmitted by said channel, and a thermal decay warning signal is generated if said amplitude of said warning signal is less than a reference amplitude.

57. (previously presented) The hard disk drive of Claim 56, wherein said early warning pattern is written to an area of said magnetic storage disk having a magnetic storage material thickness that is less than a prescribed amount in response to identifying said area of said magnetic storage disk.

58. (previously presented) The hard disk drive of Claim 57, wherein said hard disk drive identifies said area of said magnetic storage disk in response to reading servo information from said magnetic storage disk.

59. (previously presented) The hard disk drive of Claim 58, wherein said hard disk drive identifies said area of said magnetic storage disk at a factory before said hard disk drive is shipped to an end user.

60. (currently amended) The hard disk drive of Claim 58, wherein said servo information is automatic gain control information.

61. (previously presented) A method for providing an early warning of thermal decay in a disk drive, wherein the disk drive includes a magnetic disk, the disk includes a track, a test pattern on the track has a different data density than user data on the track, and the disk drive stores a reference amplitude, the method comprising:

reading the test pattern from the track to obtain an observed amplitude;

comparing the reference amplitude to the observed amplitude; and

producing a thermal decay warning signal if the comparison is unfavorable.

62. (previously presented) The method of Claim 61, wherein the test pattern is an early warning pattern that has greater susceptibility to thermal decay than any servo information and any user data on the disk.

63. (previously presented) The method of Claim 61, wherein the test pattern on the track has a higher susceptibility to thermal decay than user data on the track due to the different data density.

64. (previously presented) The method of Claim 61, wherein the test pattern on the track has a higher susceptibility to thermal decay than a 1T pattern on the track due to the test pattern on the track having a different data density than the 1T pattern on the track.

65. (previously presented) The method of Claim 61, wherein the disk includes first and second zones, the track is located in the first zone, and the test pattern has the same data density as user data in the second zone.

66. (previously presented) A method for providing an early warning of thermal decay in a disk drive, wherein the disk drive includes a magnetic disk, the disk includes a track, a test pattern on the track has a larger data density than user data on the track, and the disk drive stores a reference amplitude, the method comprising:

reading the test pattern from the track to obtain an observed amplitude;

comparing the reference amplitude to the observed amplitude; and

producing a thermal decay warning signal if the comparison is unfavorable.

67. (previously presented) The method of Claim 66, wherein the test pattern is an early warning pattern that has greater susceptibility to thermal decay than any servo information and any user data on the disk.

68. (previously presented) The method of Claim 66, wherein the test pattern on the track has a higher susceptibility to thermal decay than user data on the track due to the larger data density.

69. (previously presented) The method of Claim 66, wherein the test pattern on the track has a higher susceptibility to thermal decay than a 1T pattern on the track due to the test pattern on the track having a larger data density than the 1T pattern on the track.

70. (previously presented) The method of Claim 66, wherein the disk includes first and second zones, the track is located in the first zone, and the test pattern has the same data density as user data in the second zone.

71. (previously presented) A method for providing an early warning of thermal decay in a disk drive, wherein the disk drive includes a magnetic disk, the disk includes a track, a test pattern on the track has a smaller data density than user data on the track, and the disk drive stores a reference amplitude, the method comprising:

reading the test pattern from the track to obtain an observed amplitude;

comparing the reference amplitude to the observed amplitude; and

producing a thermal decay warning signal if the comparison is unfavorable.

72. (previously presented) The method of Claim 71, wherein the test pattern is an early warning pattern that has greater susceptibility to thermal decay than any servo information and any user data on the disk.

73. (previously presented) The method of Claim 71, wherein the test pattern on the track has a higher susceptibility to thermal decay than user data on the track due to the smaller data density.

74. (previously presented) The method of Claim 71, wherein the test pattern on the track has a higher susceptibility to thermal decay than a 1T pattern on the track due to the test pattern on the track having a smaller data density than the 1T pattern on the track.

75. (previously presented) The method of Claim 71, wherein the disk includes first and second zones, the track is located in the first zone, and the test pattern has the same data density as user data in the second zone.

76. (previously presented) A method for providing an early warning of thermal decay in a disk drive, wherein the disk drive includes a magnetic disk, the disk includes a track, a test pattern on the track has a different data density than a 1T pattern on the track, and the disk drive stores a reference amplitude, the method comprising:

reading the test pattern from the track to obtain an observed amplitude;

comparing the reference amplitude to the observed amplitude; and

producing a thermal decay warning signal if the comparison is unfavorable.

77. (previously presented) The method of Claim 76, wherein the test pattern is an early warning pattern that has greater susceptibility to thermal decay than any servo information and any user data on the disk.

78. (previously presented) The method of Claim 76, wherein the test pattern on the track has a higher susceptibility to thermal decay than the 1T pattern on the track due to the different data density.

79. (previously presented) The method of Claim 78, wherein the test pattern on the track has a larger data density than the 1T pattern on the track.

80. (previously presented) The method of Claim 78, wherein the test pattern on the track has a smaller data density than the 1T pattern on the track.

81. (previously presented) A method for providing an early warning of thermal decay in a disk drive, wherein the disk drive includes a magnetic disk, the method comprising the following steps in the sequence set forth:

identifying a sector on the disk that has a greater than average susceptibility to thermal decay;

writing a test pattern to the sector in response to identifying the sector;

reading the test pattern from the sector to obtain a reference amplitude;

storing the reference amplitude in the disk drive;

reading the test pattern from the sector to obtain a measured amplitude;

comparing the reference amplitude and the measured amplitude; and

producing a thermal decay warning signal if the comparison is unfavorable.

82. (previously presented) The method of Claim 81, wherein identifying the sector includes:

reading servo information from the disk to obtain measured servo amplitudes; and

determining a portion of the disk that has a greater than average susceptibility to thermal decay based on the measured servo amplitudes, wherein the sector is associated with the portion of the disk.

83. (currently amended) The method of Claim 82, wherein the servo information is automatic gain control information.

84. (previously presented) The method of Claim 81, wherein identifying the sector includes determining a portion of the disk in which magnetic media of the disk is thinner than an average thickness of the magnetic media of the disk, and the sector is associated with the portion of the disk.

85. (previously presented) The method of Claim 81, wherein identifying the sector includes manufacturing the disk so that magnetic media in a predetermined portion of the disk is thinner than an average thickness of the magnetic media in the disk, and the sector is associated with the predetermined portion of the disk.

86. (previously presented) A method for providing an early warning of thermal decay in a disk drive, wherein the disk drive includes a magnetic disk, the method comprising the following steps in the sequence set forth:

identifying a sector on the disk that has a greater than average susceptibility to thermal decay;

writing a test pattern to the sector in response to identifying the sector, wherein the test pattern has a greater susceptibility to thermal decay than any servo information and any user data on the disk;

reading the test pattern from the sector to obtain a reference amplitude;

storing the reference amplitude in the disk drive;

reading the test pattern from the sector to obtain a measured amplitude;

comparing the reference amplitude and the measured amplitude; and

producing a thermal decay warning signal if the comparison is unfavorable.

87. (previously presented) The method of Claim 86, wherein identifying the sector includes:

reading servo information from the disk to obtain measured servo amplitudes; and

determining a portion of the disk that has a greater than average susceptibility to thermal decay based on the measured servo amplitudes, wherein the sector is associated with the portion of the disk.

88. (currently amended) The method of Claim 87, wherein the servo information is automatic gain control information.

89. (previously presented) The method of Claim 86, wherein identifying the sector includes determining a portion of the disk in which magnetic media of the disk is thinner than an average thickness of the magnetic media of the disk, and the sector is associated with the portion of the disk.

90. (previously presented) The method of Claim 86, wherein identifying the sector includes manufacturing the disk so that magnetic media in a predetermined portion of the disk is thinner than an average thickness of the magnetic media in the disk, and the sector is associated with the predetermined portion of the disk.

91. (previously presented) A method for providing an early warning of thermal decay in a disk drive, wherein the disk drive includes a magnetic disk, the method comprising the following steps in the sequence set forth:

identifying a sector on the disk that has a greater than average susceptibility to thermal decay;

writing a test pattern to the sector in response to identifying the sector;

reading the test pattern from the sector to obtain a reference amplitude;

storing the reference amplitude in the disk drive;

shipping the disk drive from a factory to an end user;

reading the test pattern from the sector to obtain a measured amplitude;

comparing the reference amplitude and the measured amplitude; and

producing a thermal decay warning signal if the comparison is unfavorable.

92. (previously presented) The method of Claim 91, wherein identifying the sector includes:

reading servo information from the disk to obtain measured servo amplitudes; and

determining a portion of the disk that has a greater than average susceptibility to thermal decay based on the measured servo amplitudes, wherein the sector is associated with the portion of the disk.

93. (currently amended) The method of Claim 92, wherein the servo information is automatic gain control information.

94. (previously presented) The method of Claim 91, wherein identifying the sector includes determining a portion of the disk in which magnetic media of the disk is thinner than an average thickness of the magnetic media of the disk, and the sector is associated with the portion of the disk.

95. (previously presented) The method of Claim 91, wherein identifying the sector includes manufacturing the disk so that magnetic media in a predetermined portion of the disk is thinner than an average thickness of the magnetic media in the disk, and the sector is associated with the predetermined portion of the disk.

96. (previously presented) A method for providing an early warning of thermal decay in a disk drive, wherein the disk drive includes a magnetic disk, the method comprising the following steps in the sequence set forth:

writing evaluation test patterns to the disk;

reading the evaluation test patterns from the disk;

selecting a test pattern from the evaluation test patterns that exhibits the greatest amount of thermal decay;

writing the test pattern to a sector on the disk;

reading the test pattern from the sector to obtain a reference amplitude;

storing the reference amplitude in the disk drive;

reading the test pattern from the sector to obtain a measured amplitude;

comparing the reference amplitude and the measured amplitude; and

producing a thermal decay warning signal if the comparison is unfavorable.

97. (previously presented) The method of Claim 96, including subjecting the disk to elevated temperature between writing and reading the evaluation test patterns.

98. (previously presented) The method of Claim 96, wherein the test pattern has a greater susceptibility to thermal decay than any servo information and any user data on the disk.

99. (previously presented) The method of Claim 98, wherein the test pattern on a track of the disk has a larger data density than a 1T pattern on the track.

100. (previously presented) The method of Claim 98, wherein the test pattern on a track of the disk has a smaller data density than a 1T pattern on the track.